SCOPE, SEQUENCE, and COORDINATION

A National Curriculum Project for High School Science Education

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Student Materials

Learning Sequence Item:

908

Solids, Liquids, and Gases

August 1996
Adapted by: Brett Pyle and Linda W. Crow

Contents

This micro-unit was adapted by **Brett Pyle** (Grady Middle School, Houston) and **Linda W. Crow** (Baylor College of Medicine, Houston)

Student Sheet

Science as Inquiry

Presto Denso!

What is the density of liquid and solid paraffin?

Overview:

Which weighs more, a ton of feathers or a ton of bricks? Which has the greater volume? This old riddle brings up the problem of density.

How can we determine the density of some substance? Does this density change if the substance changes from a solid to a liquid? In this activity, you'll look at these problems.

Procedure:

Construct a data table for measurements of mass, volume, and density of the material tested. Measure the mass and volume of the solid paraffin chunk and then determine its density. Show your work on density calculations. Mass should be measured in grams, volume in milliliters (or cm3), and density in gm/cm^3.

Next, determine the volume of the metal bottle cap. Melt some paraffin and fill the cap with this liquid. Quickly determine the density of the liquid paraffin. Then set it aside and observe what happens as it cools.

Questions:

1. What can you conclude about the density of solids vs. liquids? Support your answer with your data.

2. Do all solids and liquids follow your conclusions? Are there any exceptions? Explain.

Science as Inquiry

Density of a Gas

What is the density of a gas?

Overview:

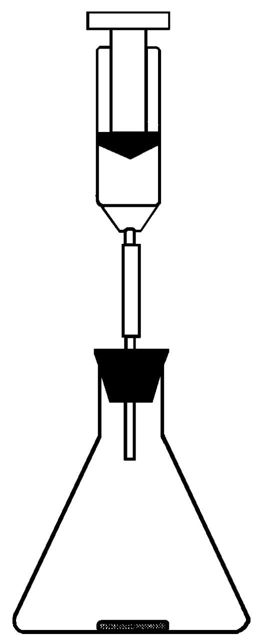
Have you ever let the air out of a tire? (Well, don't try this on your science teacher's tires!) If so, you have probably noticed that hissing sound. Why does the air make this sound? And where does this air go? This activity may help you answer these questions.

Procedure:

First you will need to determine the volume of the flask your teacher has given you. Should you just use 250 mL as the volume since the flask is a 250-mL flask? Think about it .

After determining the volume of the flask, place an Alka-Seltzer tablet in the bottom and connect a syringe containing 30 mL of water to the flask. Determine the mass of the entire apparatus.

Push the water from the syringe into the flask and stand back. Measure the mass of the entire apparatus again. Then pull out the syringe's plunger to 50 mL. Determine the mass again. Remove the stopper briefly and then re-stopper the flask. Determine the mass again!



Questions:

1. Calculate the density of the CO_2 gas when the syringe is pushed in all the way and when it is pulled out to hold 50 mL. Use the data you collected and show your work.

2. Explain why it is more difficult to determine the density of a gas than the density of a solid or liquid.

3. Why do you think we measured the density of CO_2 gas instead of H_2O gas in this experiment?

Student Sheet

Science as Inquiry

The Big Squeeze

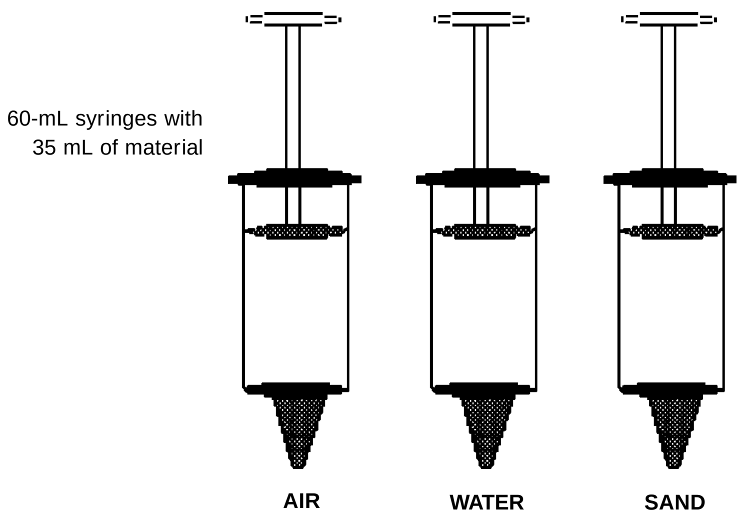
What is the density of a gas?

Overview:

Can you squeeze a solid? a liquid? a gas? Find out by doing this activity.

Procedure:

Fill three large syringes with equal volumes of water, sand, and air. Press down on the plunger of each syringe and observe what happens.



Questions:

1. What happened when you pressed the plunger on each syringe?

2. How can you explain what you observed?

Student Sheet

Science as Inquiry

Building a Model

How do solids, liquids, and gases look inside?

Overview:

Have you ever built a model? You probably used different materials to represent the real parts. In this activity you will be asked to build a model of a solid, liquid, and gas. Think back about your previous experiments for help with this one.

Procedure:

With your group, come up with a model that will explain what solids, liquids, and gases are like inside and why they behave as observed in the previous activities. Using drawings and/or words, describe your model on a large piece of paper.

Questions:

1. How does your model explain what you observed using the syringes?

2. As the paraffin changed from liquid to solid, how does your model explain what is happening?

3. Using your model, if you sliced solid pieces of paraffin into smaller pieces, what would these smaller pieces be composed of?

4. What did you use as sources of information for your model idea?

Science as Inquiry

Density of Ice vs. Water and Its Effects

Water exhibits another peculiarity as it undergoes the transition from a liquid to a solid. As the temperature of a liquid drops, its density tends to increase. This increase occurs because the individual molecules are moving more slowly and so the spaces between them decrease. The density of water also increases, until the temperature nears 4 °C. Then the water molecules come so close together that every one of them becomes hydrogen-bonded to four others, forming an open latticework. In the course of this bonding process, water expands again, so that water as a solid takes up more volume than water as a liquid.

This increase in volume has occasional disastrous effects on water pipes, but, on the whole, turns out to be so beneficial for life forms that it would seem to be almost miraculously devised. If water contracted as it froze, not only would ice cubes fail to tinkle in our glasses, but also lakes and ponds and other bodies of water would freeze from the bottom up. Once ice began to accumulate on the bottom, it would tend not to melt, season after season, and eventually the pond would freeze solid and life in the pond would be destroyed. By contrast, a layer of ice tends to protect the life of the pond, keeping the liquid water beneath it at 0 °C or above.

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